Region One
Vegetation Classification, Mapping, Inventory and Analysis Report

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The Region 1 Existing Vegetation Mapping Program (VMap) Flathead National Forest Overview; Version 12

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1. Summary

One of the most fundamental information needs to support ecosystem assessment and land management planning is consistent, continuous, and up to date vegetation data of sufficient accuracy and precision. The Northern Region Vegetation Mapping (VMap) program and products help meet this information need and provides the Northern Region with a geospatial database of existing vegetation produced using consistent analytical methodology according to the *Existing Vegetation Classification and Mapping Technical Guide* (Brohman and Bryant, 2005) to support the *Region 1 Multi-level Classification, Mapping, Inventory, and Analysis System, R1-CMIA* (Berglund et. al., 2009).

The Flathead National Forest (FNF) VMap database provides four primary map products; lifeform, tree canopy cover class, tree size class, and tree dominance type at two scales to support mid and base-level analysis and planning. VMap uses the *Region 1 Existing Vegetation Classification System (R1-ExVeg)* (Barber, et.al. 2009) in its map unit design. The R1-ExVeg system describes the logic for grouping entities by similarities in their floristic characteristics. This has been an iterative process in Region 1 as different classification schemes have been tested and evaluated for utmost utility by end users. The system was designed to allow consistent applications between Regional inventory and map products within the R1-CMIA framework.

VMap is a remote sensing derived product. As such, it uses a combination of satellite imagery and airborne acquired imagery. The image data (i.e., pixels) are put through a process of aggregation to derive spatially cohesive units (i.e., polygons). A small portion of these polygons are then sampled through aerial photo interpretation and field data collection to determine their composition and through spatial statistics, unsampled polygons are given labels based on an analysis of the sampled polygons. Draft map products are then field verified and appropriate changes are made in the labeling algorithms. Final results are then used to populate the VMap base-level feature class. A variety of post-processing algorithms are then used to create the mid-level feature classes of the VMap database.

An independent accuracy assessment was conducted to provide a validation of the data, giving an indication of reliability of the map products, so that managers are fully informed throughout the decision making process. Estimates of overall map accuracy and confidence of individual map classes can be inferred from the accuracy assessment error matrix derived from the comparison of known reference sites to mapped data. These accuracy assessment results are relevant to the entire FNF as a whole and the resulting map products show exceptional accuracies, ranging from 70-90% depending on the attribute in question. These accuracies exceed National Map Accuracy standards.

2. Overview

The two image data sources used in constructing the FNF VMap database were 30m Landsat Thematic Mapper and 1m National Agriculture Imagery Program (NAIP). These data were integrated through a multi-resolution hierarchical image segmentation process. Image segmentation is the process of combining the pixels within digital images into spatially cohesive units, or regions, thereby creating image objects. These image objects effectively depict the elements of vegetation and land cover pattern on the landscape. Training data is used to build the relationships between ground based condition (i.e., type, size, and density) and the spectral information contained within the image objects. Using these known areas, it becomes possible to construct algorithms to predict and label the unknown (i.e., unsampled) areas within a modeling unit. The results are then used to populate the VMap existing vegetation database. See *The Region 1 Vegetation Mapping Methodology* (Brown, et. al. 2011) for specific methodology, software, and algorithms used to create the VMap database.

VMap uses the Region *1 Existing Vegetation Classification System (R1-ExVeg*) (Barber, et.al., 2009) in its map unit design. The R1-ExVeg system describes the logic for grouping entities by similarities in their floristic characteristics. This system (i.e., methodology and algorithms) was developed and accepted by the Region One Vegetation Council for classifying and mapping existing vegetation including tree canopy cover, tree diameter, and tree vertical structure. The Region 1 Vegetation Council is a consortium representing multiple resource staffs at all levels of the Region and research foresters who use vegetation data to meet information needs. The system was designed to allow consistent applications between regional inventory and map products within the R1-CMIA framework. This has been an iterative process in Region 1 as different classification schemes have been tested and evaluated for utmost utility by end users. The Region 1 existing vegetation mapping process utilizes this classification and a portion of this document describes how vegetation classification units comprise "mappable" features at different levels of the mapping hierarchy (mid-, and base-levels). As a result, there is a direct link between classification units and map labels. In many situations, a classification unit and an R1-VMap map label are synonymous. The R1-ExVeg system meets, and in many cases exceeds, the requirements of an existing vegetation system as defined in the Forest Service *Existing Vegetation Classification and Mapping Technical Guide* **(**Brohman and Bryant, 2005) and the *National Vegetation Classification Standard* (FGDC NVC, 2008). The non-coniferous tree (referred to as non-forest) classification and map units are currently not included in R1-ExVeg but a brief description is provided in this document.

The VMap data is stored in each unit's SDE at the Kansas City Enterprise Data Center (EDC). Connection files that can be used into ArcCatalog are located at T:\FS\Reference\GeoTool\r01\DatabaseConnection. An additional way to access the VMap data is through the NRIS Geospatial Interface (GI). Accessing the data through the GI also provides analytic and display tools to work with the VMap data, in addition to access to other corporate data layers and analysis products. See *Accessing VMap Data; Version 11* (Barber, 2011) for more detail.

An independent accuracy assessment of the VMap products was conducted across the entire FNF. This accuracy assessment provides a validation of the data, giving an indication of

reliability of the map products, so that managers are fully informed throughout the decision making process. Too often vegetation and other maps are used without a clear understanding of their reliability. A false sense of security about the accuracy of the map may result in an inappropriate use of the map and important decisions may be made based on data with unknown and/or unreliable accuracy. Estimates of overall map accuracy and confidence of individual map classes can be inferred from an error matrix derived from the comparison of known reference sites to mapped data. For the FNF VMap accuracy assessment, there were a total of 280 samples available for assessment. Overall the resulting FNF map products show exceptional accuracies, ranging from 70-90% depending on attribute. These accuracies exceed National Map Accuracy standards which are typically 65% minimum for most attributes. Please refer to *R1-VMap Accuracy Assessment Procedures for Region 1* (Vanderzanden, et.al., 2009) and *Flathead National Forest VMap Accuracy Assessment; Version 12* (Brown, et.al., 2012) for complete details.

3. VMap Database and Map Products

The VMap version 12 release contains two feature classes (base and mid) for use at different levels of analysis and includes vegetation attributes and a few biophysical attributes (e.g., elevation, aspect, and slope). The base- level feature class contains the highest spatial and thematic resolution available with no minimum map feature size and therefore, it is subsequently very large in storage size (which can result in decreased performance for landscape scale analysis in ArcGIS). The base-level feature class should only be used for analysis of small landscapes, watersheds, projects or in applications where the analysis need requires higher spatial and thematic precision. The mid-level database, where the polygons have been allowed to "grow" larger and have had a minimum size of 1 acre applied, provides more than adequate spatial and thematic resolution for most large landscape or forest-wide analysis needs. The published accuracy assessment is applicable to the mid-level VMap product.

The following is a brief description of the vegetation attributes contained in the mid- and base-level feature classes. See *VMap Data Dictionary; Version 11* (Barber, 2011) for the complete data dictionaries of all VMap feature classes and a complete list of valid codes. See the *Region 1 Existing Vegetation Classification System and its Relationship to Inventory Data and the Region 1 Existing Vegetation Map Products* (Barber, et. al, 2009) for a complete description of these vegetation attributes.

Lifeform:

Mapped lifeform is derived from photo/image-interpretation and abundance is determined using species canopy cover, with a minimum of 10% canopy cover needed to assign dominance. Mapped lifeforms include Tree, Shrub, Herbaceous, Sparsely Vegetated, and Water with precedence order being tree, shrub, herbaceous in the lifeform key.

Tree Dominance Group 6040:

Dominance group 6040 is based on two thresholds of tree abundance: 60% and 40%. If the single most abundant tree species has greater than or equal to 60% of the total

abundance (i.e., canopy cover, basal area, or trees per acre) for all trees, the class assigned is the species label for that most abundant tree species (e.g., ABLA, PIPO). If the abundance of the single most abundant tree species is less than 60% and greater than or equal to 40% of total tree abundance, the class assigned is the most abundant species with a suffix of the tree lifeform subclass, such as PICO-TMIX or PICO-IMIX. If the abundance of the single most abundant tree species is less than 40% of total tree abundance, the class label assigned is the tree subclass (HMIX, IMIX or TMIX).

Tree Dominance 60% Plurality and 40% Plurality:

Tree dominance plurality classes are hierarchically aggregated from dominance group 6040 into two mid-level plurality classes. Dominance 60% plurality classes include only single-species classes and mixed-species classes. This creates a map with classes that are based on greater than or equal to 60% abundance of an individual species and three heterogeneous mixed species classes. Dominance 40% plurality classes consolidate all single species classes and single species-mixed species classes together based on the dominant species present. This creates a map or inventory compilation with classes that are based on greater than or equal to 40% abundance. The dominance plurality classes will also contain expansions on the non-tree lifeform classification; further splitting out the shrub types into Mesic (moist) and Xeric (dry) types and also splitting the Herbaceous lifeform into Wet/Riparian Grass, Bunch Grass, and Single-Stem Grass/Forb.

Tree Size Class:

Tree size is a classification of the predominant diameter class of live trees within a setting. It is calculated as basal area weighted average diameter (BAWAD) which is not greatly influenced by small trees. Tree size classes mapped in VMap include: 0-4.9", 5-9.9", 10-14.9", 15"+.

Tree Canopy Cover Class:

Tree canopy cover is used to describe the proportion of the ground surface covered by the vertical projection of the tree crowns. Tree canopy cover is mapped in 4 classes: 10-24.9%, 25-39.9%, 40-59.9%, 60%+.

4. References

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